TILSON

# Highway Broadband Utilization Study, Dig Once White Paper

Submitted to:
The ConnectME Authority
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# Table of Contents

# Executive Summary

The ConnectME Authority has engaged Tilson to provide a policy recommendation of how to maximize broadband development throughout Maine using the state's major road corridors. Tilson's recommendation is based on past experience in the regional and national telecommunications markets and consultation with transportation stakeholders in Maine and other U.S. states.

The following report contains four primary components:

1. Overview of broadband infrastructure currently deployed in highway easements in the Northeast U.S.
2. Overview of federal and state regulations dictating the fair market value of using the public right-of-way along Maine's highways for broadband infrastructure development.
3. Recommendation how to most efficiently leverage a Dig Once policy to deploy broadband infrastructure in Maine's highway easements with collocated power facilities.
4. Capital estimate for constructing broadband infrastructure in Maine's highway easements.

For the purposes of this study, Tilson analyzed Maine's primary controlled access highways, which include the Maine Turnpike, Interstate 295, and Interstate 95. Tilson considered broadband infrastructure to mean a fiber optic cable system capable of delivering data transmission at current broadband lending speeds. Fiber optic cable was selected as it is the most advanced wireline communications technology available today, and is the standard for supporting cutting-edge applications on highways in other U.S. states.

The report contains the following key findings:

- To meet federal regulations defining the fair market value of using Maine's highways for broadband development, state officials should utilize a model that accurately reflects local market demand, which could potentially include in-kind contributions or revenue sharing.
- In light of a potential Dig Once policy being implemented for the proposed highway energy corridor, it is critical that highway stakeholders collaborate early in the planning process to include sufficient communications infrastructure than can support future expansion in use.
- Numerous transportation agencies in other U.S. states possess a wealth of experience deploying and operating communications infrastructure in highway easements, and provide a valuable source of information for Maine officials.

Lastly, Tilson developed an estimate of the capital investment required to construct conduit infrastructure, regeneration facilities, and access points with and without collocated power facilities:

| Road Segment | Managing Entity | Capital Cost with Power Collocation | Stand Alone Capital Cost |
|---|---|---|---|
| Maine Turnpike | Maine Turnpike Authority | $ 3,037,000 | $ 5,906,000 |
| Interstate 295 | Maine Department of Transportation | $ 1,660,000 | $ 3,138,000 |
| Interstate 95 | Maine Department of Transportation | $ 5,968,000 | $ 11,694,000 |

While there is a great opportunity to support future broadband development throughout Maine using the state's highway easements, doing so will require strategic foresight and persistent collaboration among the range of stakeholders throughout the planning process.

## Current Utilization of U.S. Highway Easements

According to Title 23 of the United States Federal Code, States that receive federal funding to maintain controlled access highways must accommodate telecommunications development that does not pose a threat to automobile safety:[1][2]

> *Availability of Rights-of-Way* — In any case where sufficient land or air space exits within the publicly acquired rights-of-way of any highway, constructed in whole or in part with Federal-aid highway funds, the Secretary shall authorize a State to make such lands, air space, and rights-of-way available with or without charge to a publicly or privately owned authority or company or any other person for such purposes if such accommodation will not adversely affect automotive safety.

As a result, Department of Transportation (DOT) agencies in numerous U.S. states have developed fiber optic cable systems along public highways. The following section provides an overview of how a fiber system is installed in a highway easement, how fiber networks are being utilized in other states' highway easements, and which federal and state regulations would govern future fiber installations along Maine's controlled access highways.

### Network Components for Highway Installations

A fiber optic cable system installed in the right-of-way (ROW) easement of a controlled access highway typically consists of the following facilities:

1. Conduit bank that houses the backbone fiber cable.
2. Interconnection facilities that house equipment for regenerating the cable's optical signal, collocation space for multiple service providers' networking equipment, and splice points for connecting to other networks.[3]
3. Wireless facilities that leverage the local fiber connectivity to uplink to local transportation networks or to provide local wireless service.

While it is possible to bury fiber optic cable directly into the ground, highway fiber installations are typically located in conduit to enable shared resource use (detailed in the next section) and to ensure that facilities are protected during roadway maintenance. Maine also contains widespread subsurface ledge formations, which makes the direct bury method technically and economically unfeasible.

Interconnection facilities, which provide access points to the cable, can be hand holes or manholes depending on their location in the ROW and the quantity of cables installed. As stated above, these access points, which are usually manufactured using polymer concrete, enable users to access cable for maintenance purposes or to interconnect to other networks. Signal regeneration and carrier equipment is normally housed in 20' x 20' prefabricated concrete huts that are environmentally controlled with a backup power generator located onsite.

### Highway Fiber Installations in Other U.S. States

Based on interviews with highway stakeholders around the Northeast and past projects managed by Tilson, the primary reason DOT agencies and Turnpike Authorities have installed fiber infrastructure in

[1] For questions on the report, contact Tilson's author Eben Perkins, Consultant, at 207-358-7415 or via email at eperkins@tilsontech.com

[2] Title 23, § 142, Subpart F. U.S. Department of Transportation Federal Highway Administration website, www.fhwa.dot.gov/legsregs/title23.pdf

[3] An optical signal in a fiber cable needs to be regenerated approximately every 60 kilometers (37.5 miles).

highway easements to date has been to establish communications capabilities that support Intelligent Transportation Systems (ITS).[4]

The makeup of existing highway fiber infrastructure in the Northeast varies by state, as evidenced by the following examples:[5]

| State | Network Route | Fiber Cable Size | Total Conduit | Conduit Reserved for Third Party Use |
|---|---|---|---|---|
| Massachusetts | 55 miles on I-91 | 48F | 6 | 4 |
| New Hampshire | 19 miles on I-93 | 288F | 4 | 3 |
| New York | 144 miles on I-87 | 36F | 6 | 5 |
| Vermont | 14 miles on I-89 | 144F | 6 | 4 |

ITS is a national program that aims to use modern communications capabilities to make highway transportation safer and more efficient around the country. DOT agencies have targeted the following objectives through ITS:[6]

- Establish intelligent traveler information systems that contain real time information on travel conditions and help travelers decide how, when, and where to travel.
- Enhance monitoring capabilities on roadways to improve response time to accidents.
- Establish intelligent commercial vehicle systems that help automate paperwork processing and help public agencies improve public safety by implementing targeted inspection practices.
- Reduce roadway congestion through the automation of toll collection.

Realizing these goals requires DOT agencies to build out communications networks that can connect a central traffic management center to a range of monitoring devices at different locations, including cameras, variable speed limit signs, dynamic message signs, atmosphere sensors, and pavement sensors.[7] [8] Unlike traditional devices installed on highways that use wireless microwave backhaul, agencies now need fiber connectivity due to the significant bandwidth requirements of increasingly using cameras and optical recognition technologies.

While current fiber use in highway easements stems from ITS implementation, several states have leveraged public investment in fiber infrastructure to also expand broadband availability. By leasing

[4] As part of the study, Tilson interviewed Conrad Welzel, Government Relations Manager, Maine Turnpike Authority; Todd Pelletier, Property Office Director, MaineDOT; Meryl Mendell, ITS Project Manager, MassDOT; Donna Baron, Program Director, Massachusetts Broadband Institute, Denise Markow, TMC Director, New Hampshire DoT; Michael Doyle, Contract Manager, New York State Thruway; Robert White, Right of Way Chief, Vermont Agency of Transportation; Christa Schute, Director of Business Development, Vermont Telecommunications Authority.

[5] In Massachusetts and New York, these samples do not encompass each state's full conduit footprint along highways, but rather were selected by interviewees for discussion due to their strategic importance.

[6] New York Department of Transportation website, https://www.dot.ny.gov/divisions/operating/oom/transportation-systems/systems-optimization-section/ny-moves/what-is-its.

[7] Dynamic message signs, typically 8' x 26', are mounted on overhead sign structures and are used to convey important electronic traffic messages.

[8] New Hampshire Department of Transportation website, http://www.nh.gov/dot/media/nr2011/nr062111i93corridor.htm.

excess conduit capacity through public-private partnerships, Massachusetts and Utah in particular have pursued the expansion of statewide broadband service to support economic development.

In Massachusetts, the Massachusetts Department of Transportation (MassDOT) recently installed 55 miles of conduit infrastructure along I-91 between the New Hampshire and Connecticut borders. The agency owns the six conduits installed in the system, one of which houses MassDOT's own 48F fiber cable for ITS and another which is reserved for future MassDOT use. However, the other four conduits are leased to the Massachusetts Broadband Institute (MBI), which utilizes the route as a key segment in its statewide fiber network.

MBI was created in 2008 with the mission to extend affordable high-speed Internet access to all homes, businesses, schools, libraries, medical facilities, and government offices in Massachusetts. Using a $45 million federal grant from the 2009 American Recovery and Reinvestment Act, MBI has constructed a 1,300 mile open access, middle mile fiber network throughout Western Massachusetts to increase broadband connectivity in the region's underserved areas.

Using its own funds, MBI has installed a 288F cable in one of its I-91 conduits to link its backbone network in the north and south, and can utilize the other three conduits for future broadband expansion at its own discretion. In terms of maintenance, MassDOT is responsible for the maintenance of conduit facilities and access points, while MBI is responsible for its own network equipment and cable facilities.

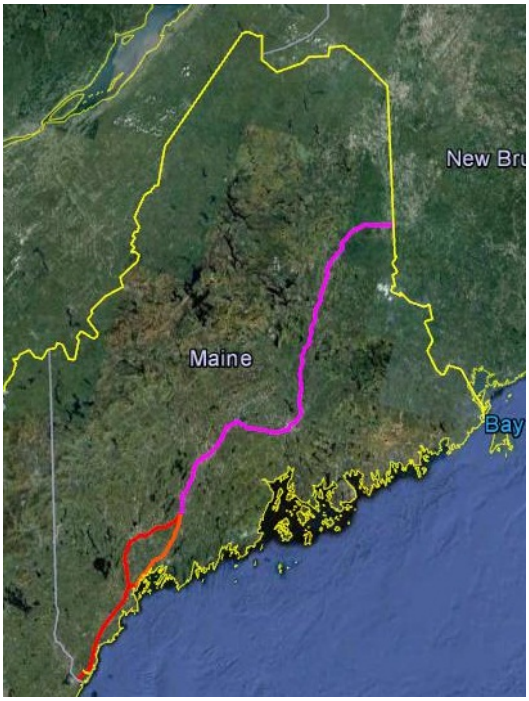
In the West, the Utah Department of Transportation (UDOT) has aggressively pursued fiber deployment in its highway easements to support a robust ITS system. UDOT's ITS network integrates more than 800 traffic signals, 1,400 detector stations, 250 closed-circuit television (CCTV) cameras, and 70 Variable Message Signs across the state's 5,800 miles of roadway. However, unlike most DOT agencies, UDOT has also built public/private partnerships directly with local telecom carriers in which the agency trades excess conduit capacity with the private companies for access to fiber in other areas of the state. Using this approach, UDOT has doubled its network footprint, with 800 miles of fiber owned by the agency and the use of nearly 1,000 miles obtained in trade.

It is important to recognize that Massachusetts' and Utah's models differ in terms of who owns and manages the fiber assets. More specifically, UDOT negotiates directly with private telecom carriers and MBI manages a publicly-owned, open access network independent of MassDOT. That being said, both states have developed strategic partnerships to leverage highway fiber infrastructure for broadband expansion.[9] While the ConnectME Authority does not own any fiber optic facilities, unlike MBI and UDOT, it could serve in an important convening and coordinating role to help establish public/private partnerships in the future.

[9] Stakeholders in each state emphasized the importance of ongoing political support for facilitating continued collaboration between state DOT agencies and shared resource users.

## Regulations on Potential Installations in Maine

As shown in the map of the Maine presented below, the state's primary controlled access highways include the Maine Turnpike (red line), I-295 (orange line), and 1-95 (pink line):




Considering potential ITS expansion along Maine's highways, fiber installations by either the Maine Turnpike Authority (MTA) or the Maine Department of Transportation (MaineDOT) would be governed by federal and state policies set forth by the U.S. Federal Highway Administration (FHWA) and MaineDOT respectively.

At the federal level, FHWA published its *Program Guide: Utility Relocation and Accommodation on Federal-Aid Highway Projects* in 2003 to provide implementation guidelines for access to the highway ROW and guidance on competitive procurement:[10]

1. The State retains the right and responsibility to manage its freeway ROW and may place reasonable, nondiscriminatory restrictions on design, installation, operation and maintenance of fiber optic facilities along freeway ROW.
2. Construction should be done as far from the traveled roadway as feasible
3. If all construction vehicles, equipment, and personnel can be located outside the clear zone, then the State should allow access to freeway ROW as frequently as reasonably necessary to satisfy the needs of telecom providers, though the state may limit installations to one project at a time on any major segment of freeway ROW.
4. If all construction vehicles, equipment, and personnel cannot be located outside the clear zone, then the State may restrict access to freeway ROW to a one-time installation with excess capacity to address subsequent vendor needs. Once excess capacity has been exhausted, then the state should allow additional installations as necessary to satisfy telecom vendor requirements.

[10] U.S. Department of Transportation Federal Highway Administration website, http://www.fhwa.dot.gov/reports/utilguid/index.htm; http://www.fhwa.dot.gov/realestate/guidutil_a.htm

5. Above ground equipment may be restricted to the edge of ROW or off ROW with service access from service roads or other non-freeway access where feasible.

At the state level, MaineDOT's 2009 *Utility Accommodation Policy* lays out specific guidelines for installing communications infrastructure in the public right-of-way.[11] While new wireline facilities, including fiber optic cable, are not normally permitted within highway easements, MaineDOT may elect to permit such installations that meet the following criteria:[12][13]

1. The accommodation will not adversely affect Highway and traffic safety.
2. That alternate locations are not available or cannot be implemented at reasonable cost, from the standpoint of providing efficient service in a manner conducive to safety, durability, and economy of maintenance and operations.
3. The accommodation will not adversely affect the design, construction operation, maintenance, or stability of the Freeway.
4. The accommodation will not interfere with or impair the present use or future expansion of the Freeway.
5. The accommodation will be shown to be in the substantial public interest of the State of Maine.

As demonstrated in the Utah and Massachusetts examples, shared resource use of highway fiber infrastructure requires collaboration among multiple parties. Current implementation regulations focus on specific requirements for accommodating new communications facilities in the public ROW, but do not address management structure. In other words, structuring shared use networks is left up to Maine's highway and broadband stakeholders. The following section details this shared resource model, including the regulatory requirements that govern multiple party use of highway fiber infrastructure.

[11] See Appendix A for a copy of MaineDOT's Utility Accommodation Policy.

[12] Tilson believes this prohibition that would likely be preempted by a legal challenge under the federal Telecommunication Act of 1996, which is more fully described in the follow sections.

[13] Maine Department of Transportation website, http://www.maine.gov/mdot/utilities/uap.htm.

## Valuing Maine's Highway Easements for Shared Use

This study is being performed at a unique period in the history of Maine's highway system. In 2012, the State Legislature passed LD 1786, which created an Interagency Review Panel (IRP) to oversee the development of a high-voltage power transmission cable between Orrington, ME and the New Hampshire border using the public ROW along the Maine Turnpike, I-295, and I-95.[14][15]

In the process of gathering Letters of Intent from interested developers, the IRP began to explore the opportunity to collocate a fiber optic cable system with the energy infrastructure. At present, the IRP has indicated a preference that the energy developer will own and manage the fiber infrastructure. In terms of valuing the easement, the IRP is mandated to identify an initial range of value for the use of state-owned land or assets within the statutory corridor.

At the federal level, valuation for use of the public highway ROW stems from Title 23 in the U.S. Code, which stipulates that a State must charge, at a minimum, fair market value for the use or lease of real property acquired with Federal assistance from the Highway Trust Fund.[16] This was implemented in Section 253 of the Telecommunications Act of 1996, which sets forth a distinct precedent for supporting competitive communications provision:[17]

(a) *In General*. No State or local statute or regulation, or other legal requirement, may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service.
(b) *State Regulatory Authority*. Nothing in this section shall affect the ability of a State to impose, on a competitively neutral basis and consistent with section 254, requirements necessary to preserve and advance universal service, protect the public safety and welfare, ensure the continued quality of telecommunications services, and safeguard the rights of consumers.
(c) *State and Local Government Authority*. Nothing in this section affects the authority of a State or local government to manage the public rights-of-way or to require fair and reasonable compensation from telecommunications providers, on a competitively neutral and nondiscriminatory basis, for use of public rights-of-way on a nondiscriminatory basis, if the compensation required is publicly disclosed by such government.
(d) *Preemption*. If, after notice and an opportunity for public comment, the Commission determines that a State or local government has permitted or imposed any statute, regulation, or legal requirement that violates subsection (a) or (b), the Commission shall preempt the enforcement of such statute, regulation, or legal requirement to the extent necessary to correct such violation or inconsistency.

As spelled out in Parts A and C, Section 253 forbids any government action that prohibits or has the effect of prohibiting competition in providing telecom services using the public ROW. In other words, state transportation agencies cannot use unfair pricing to prevent private telecom carriers accessing shared use conduit located in highway easements. While there have been no such legal challenges made

[14] Maine State Legislature website, http://www.mainelegislature.org/legis/bills/bills_124th/chappdfs/PUBLIC655.pdf.
[15] LD 1786 requires the Maine Turnpike Authority to approve the terms of any occupancy agreement for use of Maine Turnpike Authority property within the Interstate 95 corridor that is consistent with the memorandum of agreement made by MaineDOT.
[16] Title 23, § 156, Subpart A. U.S. Department of Transportation Federal Highway Administration website, www.fhwa.dot.gov/legsregs/title23.pdf.
[17] The Library of Congress website, http://thomas.loc.gov/cgi-bin/query/F?c104:1:./temp/~c104WB6njY:e48061:.

against a state DOT to date, the statute begs the question of how to determine "fair and reasonable compensation" in a shared use scenario.

## Valuation Methodologies

According the Maryland Department of Transportation's (MDOT) *Strategy for Accommodating Fiber Optics Along Maryland Highway Rights-of-Way*, which was published in 2002 to help the state govern conduit use in the high demand I-95 corridor, there are several ways to value highway easements:[18]

- Across-the-fence (ATF) valuation – value of adjacent properties utilized to establish easement value using one of several formal appraisal techniques.
- Historical experience (Comps) – data reported from other market transactions synthesized and utilized as a proxy for fair market value and/or to establish a range of expected values.
- Income-based valuation – percentage of revenues derived from installed facility charged as compensation for easement rights.
- Competitive bidding – bids received in response to competitive solicitation utilized to establish appropriate compensation level.
- Cost recovery methods – fees established to recover program administration.

Valuation is impacted by a number of factors, including location, infrastructure security, constructability, availability of alternate routes, length of corridor, connectivity to major population centers and/or existing long-haul fiber routes, and number of conduits installed.

According to Title 23, fair market value may be determined "on a best value basis, highest net present value of the payments to be received over the lifetime of the agreement, or highest bid received as specified in the request for proposals."[19] The regulation stipulates that any concession agreement awarded pursuant to a competitive process with one bidder *or* multiple bidder(s) is deemed to be fair market value.

If a concession agreement is not awarded pursuant to a competitive process, Title 23 requires that fair market value is determined by the highway agency in accordance with State law, so long as an independent third party assessment is conducted and made publicly available. However, Maine's Statute Title 23 only addresses fair market valuation in the context of new property acquired for road expansion.[20]

To date, there have been a number of legal cases between ROW owners and the telecom industry over how to determine "fair and reasonable" compensation for broadband development. It is important to note that ROW in these cases is not limited to controlled access highways, but rather includes all public roadways. Initially, courts dictated that fair and reasonable compensation should be limited to the costs of administering the public right-of-way for telecom development. [21][22] This decision is evidenced in the

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[18] Pg. 13, Edwards and Kelcey, Inc. (2002). *Strategy for Accommodating Fiber Optics Along Maryland Highways Rights-of-Way*. Developed for Maryland Department of Transportation. A copy is included in Appendix A.

[19] CFR Title 23, Chapter 1, Subchapter H, Part 710, Subpart G, Section 710.709, Legal Information Institute, http://www.law.cornell.edu/cfr/text/23/710.709.

[20] Maine State Legislature website, http://www.mainelegislature.org/legis/statutes/23/title23ch0sec0.html.

[21] *Bell Atlantic-Maryland, Inc. v. Prince George's County, Maryland,* available at http://scholar.google.com/scholar_case?case=8827488074977844794&q=bell+atlantic+maryland+inc+v.+prince+George%27s+county+maryland&hl=en&as_sdt=2,30&as_vis=1.

[22] *AT&T Communications, SW v. City of Dallas,* available at http://www.leagle.com/xmlResult.aspx?xmldoc=2001585249F3d336_1559.xml&docbase=CSLWAR2-1986-2006.

2000 and 2001 cases of *Bell Atlantic-Maryland, Inc. v. Prince George's County, Maryland AT&T Communications, SW v. City of Dallas* respectively.

However, courts have more recently expanded the definition of fair and reasonable compensation to include recurring leasing fees based on profitable use of the ROW. As Edwards and Kelcey, Inc. point out in their recent work for Maryland DOT, the 2004 decision of *TCG of Detroit v. City of Dearborn* takes four case-by-case factors into account in determining fair and reasonable pricing for accessing public ROW.[23] These factors include "the extent of use of the public ROW, whether other carriers have agreed to comparable compensation, the course of dealings among parties, and whether the compensation sought is so excessive that it is likely to render doing business unprofitable."[24]

Overall, it appears that fair market value for using the public ROW for shared use telecom purposes is an evolving notion. For Maine officials, the key lesson from recent legal cases is that any shared resource use of the highway easement requires a holistic understanding of how new fiber infrastructure impacts the local telecom market.

## Existing Valuation Models for Shared Use

State DOTs have taken a variety of approaches to fair market valuation in implementing shared use models for highway fiber optic facilities. For instance, Utah DOT has established five different zones in its fiber network, each of which has a compensation schedule for third party access that is based on route location, proximate land use, and population density.[25] Each schedule uses average land values as a proxy for the ROW easement, which are based on local property values and thus produce corridor-specific rates. This flexible pricing methodology allows UDOT to arrange deals with local telecom carriers that are responsive to specific, spot market conditions. As a result, UDOT possesses high carrier demand.

In contrast, the Indiana Toll Road recently managed a competitive solicitation among private telecom carriers to determine fair market value for accessing its ROW. In order to measure the quality of the proposals and conduct an informed negotiation, the Toll Road used values from existing leasing agreements for accessing other highway and rail ROWs in the state. The values were then weighted according to whether the easements are located in urban or rural areas, which enabled the Toll Road to create a total expected value for its own ROW based on its urban-rural footprint. This method is known as comparables.

## Valuation Considerations in Maine

If Maine's highway easement is to be used with the mission to expand broadband availability throughout the state, the ownership and operating model for a fiber installation must be structured to support shared use. If MaineDOT and/or MTA own the conduit system in the ROW, achieving this goal requires the agencies to implement a fair market valuation strategy that attracts private telecom carriers.

Using a comparables method in Maine, like the Indiana Toll Road did, is problematic because market information on the local use of telecom conduit is limited. Due to Maine's rural geography, the state's

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[23] *TCG of Detroit v. City of Dearborn,* available at http://caselaw.findlaw.com/mi-court-of-appeals/1261464.html

[24] Pg. 16, Edwards and Kelcey, Inc. (2002). *Strategy for Accommodating Fiber Optics Along Maryland Highways Rights-of-Way*. Developed for Maryland Department of Transportation.

[25] Rule R907-65, *Compensation Schedule for Longitudinal Access to Interstate Highway Rights-of-way for Installation of Telecommunications Facilities*, available at http://www.rules.utah.gov/publicat/code/r907/r907-065.htm.

telecom infrastructure is almost entirely aerial. In other words, nearly all fiber optic cable currently installed throughout the state is attached to roadside utility pole lines since it is a less expensive method construction method than deploying fiber underground. The cities of Portland and Bangor have the state's only substantial concentration of conduit, but even there the majority of fiber cable is aerial.

Consequently, there are few entities in the state that lease conduit infrastructure to others for communications purposes. Leading Internet Service Providers (ISPs) like Time Warner Cable, Oxford Networks, and OTT communications use conduit owned by FairPoint Communications, the state's primary incumbent local exchange carrier, and Central Maine Power where necessary. FairPoint's leasing rates for conduit are as follows:

NORTHERN NEW ENGLAND TELEPHONE OPERATIONS LLC
d/b/a FAIRPOINT COMMUNICATIONS - NNE
CONDUIT OCCUPANCY FEES

Annual Conduit Occupancy Fees per foot are as follows:

| State | Partial Duct | Full Duct |
|---|---|---|
| ME | $0.90 | $1.80 |
| NH | $1.05 | $2.10 |
| VT | $0.85 | $1.70 |

Examining Maine's highway easements, it is clear that fiber infrastructure along the Maine Turnpike, I-295, and I-95 could provide a backbone that directly connects the state's primary population centers in Portland/Brunswick, Lewiston/Auburn, Augusta/Waterville, and Bangor, and provides an additional redundant route in Maine Fiber Company's Three Ring Binder footprint. That being said, Tilson believes there is greater potential to attract private companies in the southern half of the state to construct last-mile connections into surrounding towns due to the region's higher population density. Private telecom carriers have minimal economic incentive to construct last mile connections to the rural towns around I-95 between Waterville and Bangor, and north of Bangor into Aroostook County.

One might argue that Utah's model for valuing segments of road would apply well to Maine's variable urban-rural makeup. However, in light of the varying local demand, Tilson believes fair market valuation of the highway easement should take a stricter market-based approach. Since the economics of each deal with ISPs is highly market dependent, the value of the highway easement could potentially fall to zero if there is no business case for a company to construct facilities. In other words, the conduit owner will not receive any leasing revenue if private companies do not have a use case for the highway easement.

Based on this evaluation, the evident question is how to entice private companies to install fiber cable in highway conduit infrastructure while maintaining a fair and reasonable compensation schedule that does not violate the Telecommunications Act of 1996. One potential alternative to an upfront lease requirement is to put a revenue-sharing model in place based on consummated fiber leases that utilize the easement's infrastructure.

## Recommendations for a Dig Once Policy

As the Federal government has recently taken a leadership role in Dig Once for highway fiber installations, many states, including Maine, may consider such a policy locally. If a Dig Once policy is implemented in Maine, it is critical that broadband stakeholders understand its ramifications on designing highway fiber infrastructure for shared use. In the case of Maine's highway energy corridor, all fiber facilities must be designed to enable users to perform necessary maintenance and potential expansion without disturbing the collocated power facilities.

There are a number of potential outcomes for construction of the energy infrastructure corridor:

1. No telecom infrastructure is included in the trench.
2. The developer installs a single conduit in the trench, which MaineDOT and/or MTA could lease for their own ITS uses.
3. The developer installs multiple conduits in the trench for shared use, which MaineDOT, MTA, and/or a private telecom carrier can lease.

It is evident that the first outcome does not support increasing broadband availability using the state's highway easement. In the second scenario, a private telecom entity could feasibly support broadband expansion in communities located adjacent to the highway if the cable operator provides dark fiber access on a nondiscriminatory basis to serve new last mile connections.

This scenario would entail installing a MaxCell (or similar) divider or rigid inner duct in the conduit to accommodate multiple cables, and installing a 288F, 432F, or 576F cable to enable growth in cable utilization. Considering typical conduit and cable widths, 1.25" and 2" HDPE ducts could house multiple 144F and 288F cables respectively. According to Prysmian, a leading fiber cable manufacturer, its 144F LT2.0 and standard loose tube cables are .58" and .71" wide respectively, and its 288F LT2.0 and standard loose tube cables are .70" and .80" wide respectively.

In the third outcome, users of the fiber infrastructure would each have access to a conduit dedicated to their own fiber cable, with shared use hand holes. In terms of access points, Tilson believes that shared use hand holes are the most feasible solution in Maine due to their high cost.

In Vermont and New Hampshire, the state DOTs have installed separate access points for each individual conduit to provide exclusive access to for each user. In Massachusetts, MassDOT constructed its own access points for its two conduits, and then put in place 33 shared access locations for the four conduits that MBI is currently leasing. In New York, the New York State Thruway Authority (NYSTA) has shared use access points for its six conduits installed along I-87 from Yonkers to Albany, which also run west along I-90 through Utica, Syracuse, Rochester, and Buffalo to the Pennsylvania border. Taken all together, this route spans 496 miles, and does not include for additional conduit along I-90 from Selkirk to the Massachusetts border (24 miles), and portions of I-190 in Buffalo (5 miles) and I-287 from Tarrytown to White Plains (4 miles).

Since installing multiple conduits is an expensive endeavor, it is important to consider possible use options if a single conduit is necessary. That being said, broadband stakeholders must understand that DOT agencies in other states strongly prefer to have their own conduit for ITS fiber. Keeping this in mind during the planning and design process will facilitate future use of the infrastructure and broadband expansion.

## Capital Investment Estimate for Installation

Constructing a fiber optic cable system in the highway easement entails a variety of costs, including:

- Materials
  - Conduit duct
  - Hand holes
  - Bridge attachment hardware
  - Fiber optic cable
  - Communications huts and generators
- Labor
  - Conduit installation
  - Fiber cable installation into conduit
  - Cable splicing
  - Hand hole installation
  - Site work for communications huts
  - Traffic control
- Other
  - Water crossing permits
  - Railroad crossing permits[26]

Based on these cost components, Tilson estimates an average per mile cost of $30,000 for installing single conduit infrastructure along the full route mileage of the Maine Turnpike (101 miles), I-295 (52 miles), and I-95 (202 miles).

While this figure may seem high compared to aerial roadside fiber installations, there are major cost savings for deploying fiber in a Dig Once scenario with collocated power facilities. Tilson estimates that installing conduit infrastructure without collocated power facilities would cost roughly $58,400 per mile. This increase in cost is due to the trenching requirements of a greenfield deployment. Based on labor quotes from local contractors, current rates for trenching, which includes digging the hole and placing the conduit bank, run approximately $6.30 per foot, whereas laying conduit bank in an open trench only costs $2.10 per foot.

It is also important to note that there are fixed and variable construction costs that depend on the number of conduits installed. A single conduit system requires the same access and regeneration facilities that a system with multiple conduits needs. Tilson estimates that adding additional conduit duct along Maine's highways has incremental per mile cost of $23,300 for deployment costs, as presented in the following table for up to a three conduit system:

| Road Segment | 1-Conduit System | 2-Conduit System | 3-Conduit System |
|---|---|---|---|
| Maine Turnpike | $ 3,038,000 | $ 5,497,000 | $ 7,956,000 |
| Interstate 295 | $ 1,660,000 | $ 3,021,000 | $ 4,382,000 |
| Interstate 95 | $ 5,968,000 | $ 10,407,000 | $ 14,845,000 |

[26] Railroad fees vary significantly by rail operator, with costs ranging from $1,000 to $7,000 per crossing.

As noted above, these capital estimates do not include the cost for purchasing and installing fiber cable (with splicing) in the conduit ducts. Based on materials and labor quotes, Tilson estimates that deploying fiber cable will have the following approximate per mile costs:

| Fiber Cable Size | Per Foot Materials Cost | Total Per Mile Cost (with Installation) |
|---|---|---|
| 144F | $ 0.87 | $ 10,850 |
| 288F | $ 1.58 | $ 15,150 |
| 432F | $ 2.36 | $ 20,100 |

Lastly, Tilson's estimates do not contemplate potential connections from the backbone fiber cable to ITS devices along the highway. Completing these connections requires installing additional conduit, and, where the device is located in the opposite median, requires using a directional bore method to cross the conduit under the northbound and southbound lanes.

## Conclusion

While effectively planning highway telecom infrastructure is a complex process that involves a range of stakeholders, including shared use fiber optic facilities in Maine's planned energy corridor presents a major opportunity to further advance recent expansion of the state's broadband availability. Moving forward, it is key that the multiple stakeholders involved maintain clear communication if fiber infrastructure utilization is going to be maximized throughout the state.

# About Tilson

Tilson is a 65-person telecommunications and IT consulting firm with a world-wide practice, and team members located in Maine, New Hampshire, Massachusetts, New York, and Switzerland. Tilson offers services to industry and government in the following areas:

*Fiber optic design and deployment*

- Engineering
- Pole and conduit licensing
- Materials procurement
- Implementation management
- Regulatory registrations and support
- Operation and maintenance

*Wireless design and deployment*

- RF Engineering
- Site acquisition
- Construction management
- Operations and maintenance
- Smart grid deployment
- Distributed Antenna Systems (DAS) and micro site installation
- Tower site management

*Information Technology*

- GIS technology
- Software and web development
- Infrastructure and system project management
- Information Security

Tilson has managed the planning, design and construction of nearly a dozen fiber optic deployments throughout New England and the mid-Atlantic. Most recently, Tilson managed the deployment of the Maine Three Ring Binder and *MassBroadband123*, two large large-scale, publicly-funded fiber optic networks in rural Maine and Massachusetts.

Maine Fiber Company, Inc.'s Three Ring Binder is a 1,100 mile fiber optic project designed to deliver high-speed broadband connectivity to rural communities throughout Maine. The project leveraged $25 million in public American Recovery and Reinvestment Act funds and $7 million in private equity. The project began in September 2010 and was completed in June 2012 six months ahead of schedule and under budget. Massachusetts Broadband Institute's *MassBroadband123* is a 1,300 mile fiber optic project designed to bring broadband service to the rural regions of Central and Western Massachusetts. Costing nearly $90 million, the project leverages $45 million in public American Recovery and Reinvestment Act (ARRA) funds and equal matching funds from the State of Massachusetts. As part of each engagement, Tilson provided strategic planning, route design and engineering, cost estimation, procurement, construction management, and commissioning services.